Pre Calculus Core Curriculum Map

	Standard	Content Objective (a, b, c, d, etc. are not sequential or separate concepts, but rather are a focus that should be included in the instruction for each type of function)	Process Standard/Objective	Suggested materials/strategies (organized for the whole month, not by objective)
September	Algebra Measurement Algebra Data Analysis and Statistics Algebra Algebra & Geometry Algebra Number and Operation	**2.2.5** - Using a variety of methods, review solving systems of linear equations involving three variables. Then, extend to more than three variables. **2.1.1, 2.2.9** - From graphs of real-world situations, identify the domain and range of functions and intervals over which the function is increasing or decreasing without specifically identifying the type of graph. **2.1.1 a**. - Select appropriate viewing windows for graphs of real-world situation **4.1.1 b.** - Select appropriate units and scales for situations involving measurement **2.2.7 c**. - Identify the x and y intercepts, zeros (roots), maxima and minima of functions **5.1.1** - Given a variety of data and graphs, select a function of best fit from linear, quadratic and radical data **2.1.1, 2.2.1, 2.3.1, 2.3.6**. - Explore polynomial functions. Include each of the following ideas as part of that exploration. (Some ideas may be investigated concurrently rather than sequentially) **5.1 a.** - Gather and plot real-world data **5.1.1 b**. - Discover the regression equation appropriate for the data **2.1.1 c.** - Generalize the equation **2.3.2, 2.3.3, 2.2.9 d**. - Identify the domain, range and other attributes for the equation including local, global and end behavior. Recognize symmetric properties of even and odd functions. Determine intervals over which a function is increasing or decreasing. **3.2.1, 2.3.5 e**. - Perform transformations and identify the effect of changing parameters in those transformations of the function **2.2.1 f**. - Solve equations including real-world situations **5.1.2 g.** - Interpolate and extrapolate from data using regression equations **2.2.1 h**. - Solve inequalities including real-world situations **2.2.3, 2.2.4 i**. - Combine and compose functions students have previously experienced, identifying the domain and range of the resulting function. 1. Use algebraic methods 2. Use Technology **2.2.8 - j**. Approximate instantaneous rates of change, and find average rates of change using graphical and numerical data. **2.1.2** - Solve polynomial equations using the Rational Root Theorem	**Problem solving:** Select and use appropriate methods for computing from among mental, estimation, paper and pencil, calculator or computer. Look for a pattern. Make a table, graph or equation. "Where have we seen a problem like this before." Solve a variety of multi-step, non- routine complex problems including applications, patterning, open-ended and extended problems. **Reasoning and proof**: Link problem solving to a sequence of steps. Examine patterns and note regularities and irregularities. **Communication:** Employ precise language. Organize and consolidate thinking using written reflections, group discussion and oral presentations. Written reports. **Connections:** Recognize and apply ideas outside the classroom and in other curricular areas **Representation:** Use a variety of visual representations including graph paper, technology and models Represent math concepts with appropriate symbolic notation	Have students find and bring data through internet search, magazines, newspapers and almanacs Have students match graphs to real-world situations and vice versa Graphing calculator (delta list for rates of change). CBL Functioning In The Real World (book) Addison-Wesley, Chapter 1 Have students gather data that might be represented by a polynomial model, then keep their data for the class to use. CBL Experiment Workbook published by Texas Instruments Granite District Math Web page has excellent links with data categorized by function. Use cooperative structures to help students communicate ideas. See polynomial suggestions in September.

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October	Algebra Data Analysis and Statistics Geometry & Algebra Algebra Data and Statistics Algebra Data and Statistics Algebra Geometry and Algebra	**2.2.1, 2.3.1, 2.3.6.** - Explore power functions. Include each of the following ideas as part of that exploration. (Some ideas may be investigated concurrently rather than sequentially) **5.1 a.** - Gather and plot real-world data **5.1.1 b**. - Discover the regression equation appropriate for the data **2.1.1 c.** - Generalize the equation **2.3.2 d.** - Identify the domain, range and other attributes for the equation including local, global and end behavior **3.2.1, 2.3.5 e.** - Perform transformations and identify the effect of changing parameters in those transformations of the function **2.2.1 f.** - Solve equations including real-world situations **5.1.2 g.** - Interpolate and extrapolate from data using regression equations **2.2.1 h.** - Solve inequalities including real-world situations **2.2.3, 2.2.4 i.** - Combine and compose functions students have previously experienced, identifying the domain and range of the resulting function. 1. Use algebraic methods 2. Use Technology **2.2.8 j.** - Approximate instantaneous rates of change, and find average rates of change using graphical and numerical data. **2.1.1, 2.2.1, 2.3.1, 2.3.6** - Explore rational functions. Include each of the following ideas as part of that exploration. (Some ideas may be investigated concurrently rather than sequentially) **2.3.1 a.** - Represent quantitative, real-world situations using rational functions **2.3.2 b.** - Identify the domain, range and other attributes for the equation including asymptotes and end behavior **2.3.5, 3.2.1 c.** - Perform transformations and identify the effect of changing parameters in those transformations of the function **2.2.1 d.** - Solve equations including real-world situations **2.2.1 e.** - Solve inequalities including real world situations. **2.1.2** - Simplify expressions using polynomial long division **2.1.2** - Simplify expressions using partial fractions **2.3.4** - Relate the graphical representation of discontinuities and end-behavior	**Problem solving:** Propose, critique and value alternative approaches to solving problems. Make a model or simulation. Solve simpler or related problems. Draw a picture or diagram. Check for reasonableness of results. Guess and check.. "How are these problems related?" **Reasoning and proof:** Make, write and investigate mathematical conjectures. Employ precise language and notation. **Communication:** Express mathematical ideas coherently and clearly to peers, teacher and others. **Connections:** Formulate real-world situations that require extended investigations and solve them. Find applications in newspapers, magazines, television internet or other sources. **Representation:** Represent mathematical concepts using physical models, visualizations and appropriate symbolic notations. Represent problem situations verbally, numerically, graphically, geometrically and algebraically.	CBL, CBR, graphing calculators (delta list for rates of change) Drop racquetballs using Bounce Program or Ball Drop. Real World Math and Physics, published by Texas Instruments Wind Chimes activity (The length of a pipe versus the pitch is y = k * X^ -2 Box problem Garden fencing with expanding area (A string of connected raffle tickets are great for a border because the perforated folds facilitate changing the width and length of the fence.) Light intensity-using light meter. Have students find and bring data through internet search, magazines, newspapers and almanacs Use cooperative structures Revisit the activities suggested above in power functions Graphing calculator, CBL, CBR, Transformation Application for TI-83 Economics (price and demand are inversely proportional)

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November	Algebra Data and Statistics Algebra Data and Statistics Algebra Geometry & Algebra Algebra	**2.1.1** - Introduce the need for piece-wise functions involving those functions students have previously explored. Identify the domain and range and other attributes. **2.3.1, 2.3.6** - Explore exponential functions. Include each of the following ideas as part of that exploration. (Some ideas may be investigated concurrently rather than sequentially) **5.1 a.** - Gather and plot real-world data **5.1.1 b.** - Discover the regression equation appropriate for the data **2.1.1 c.** - Generalize the equation **2.3.2 d.** - Identify the domain, range and other attributes for the equation including asymptotes and end behavior **2.3.5, 3.2.1 e.** - Perform transformations and identify the effect of changing parameters in those transformations of the function **2.2.1 f.** - Solve equations including real-world situations **5.1.2 g.** - Interpolate and extrapolate from data using regression equations **2.2.1 h.** - Solve inequalities including real-world situations **2.2.3, 2.2.4 i.** - Combine and compose functions students have previously experienced, identifying the domain and range of the resulting function. 1. Use algebraic methods 2. Use Technology **2.2.8. j.** - Approximate instantaneous rates of change, and find average rates of change using graphical and numerical data. **1.3.3 k.** - Develop and use the limit definition of e **2.1.1, 2.2.1, 2.3.1, 4.1.2** - Introduce, define and recognize the need for logarithms (common and natural) in the real world. Recognize the changes in magnitude with various measurement scales, e.g. Richter Scales, pH, decibel **2.2.1, 2.1.1** - Compare logarithmic and exponential functions and graphs recognizing inverse relationship **2.1.2, 2.2.1**- Using properties of logarithms, simplify logarithmic expressions.	**<u>Problem solving:</u>** Draw a picture or diagram. Make a model or simulation. Check for reasonableness of results. Propose, critique and value alternative approaches. "What made you think of that?" "How are these ideas related?" Estimate solutions to problems and use estimation to determine reasonableness. **<u>Reasoning and proof:</u>** Examine patterns. Note regularities and irregularities. Identify information as necessary, sufficient, or extraneous and conclusions as valid or invalid. Realize that stating a conjecture related to a pattern does not constitute a proof. **<u>Communication:</u>** Express ideas coherently and clearly to peers, teachers and others through discussion and written responses. Use class and group discussion to organize thinking. **<u>Connections:</u>** Formulate real-world situations that require extended investigations, solve them and justify answers. Connect mathematical expressions to physical models and real-world situations. Explore historical contributions to mathematics. **<u>Representation:</u>** Represent problem situations verbally, numerically, graphically, geometrically	Real World Math and Physics, published by Texas Instruments For data, which does not exactly fit the model: transform the data to fit the exponential model, then curve fit the transformed data. Transform the regression equation to fit the original data. For example, data for a liquid cooling in a refrigerator does not exactly fit the model, but can be shifted down to fit the exponential model The musical scale is exponential (frequencies for each note in an octave) Family tree (generations are exponential.) Spaghetti activity (Mark spaghetti strand in centimeters. Suspend cup with Skittles or marbles from spaghetti bridge. As marbles are added, spaghetti breaks. Suspend from shortened piece. Relation between length and weight is exponential. Toss thumbtacks or M and Ms to consider exponential decay. (With each throw, take out all that have M on candy, or point up on thumb tacks to illustrate half life) Logarithm comes form Napier because he felt it was logical arithmetic (logarithm) Earthquakes PH values Sound (decibels)

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December	Algebra Data and Statistics Algebra Geometry & Algebra Algebra	**2.1.1, 2.2.1, 2.3.1, 2.3.6** - Explore logarithmic functions. Include each of the following ideas as part of that exploration. (Some ideas may be investigated concurrently rather than sequentially) **5.1 a**. - Gather and plot real-world data **5.1.1 b**. - Discover the regression equation appropriate for the data **2.1.1 c.** - Generalize the equation **2.3.2 d**. - Identify the domain, range and other attributes for the equation including asymptotes and end behavior **3.2.1, 2.3.5 e**. - Perform transformations and identify the effect of changing parameters in those transformations of the function **2.2.1** - Solve equations involving logarithms **2.2.1 f**. - Solve equations including real-world situations **5.1.2 g**. - Interpolate and extrapolate from data using regression equations **2.2.1 h.** - Solve inequalities including real-world situations **2.2.3, 2.2.4 i**. - Combine and compose functions students have previously experienced, identifying the domain and range of the resulting function. 1. Use algebraic methods 2. Use Technology **2.2.8 j**. - Approximate instantaneous rates of change, and find average rates of change using graphical and numerical data.	**Problem solving:** Extend knowledge by considering the thinking strategies of others. "Did anyone think about this another way?" Choose an appropriate operation. Eliminate possibilities. Use proportional reasoning. **Reasoning and proof**: Explain and justify problem solving procedures. Examine patterns, note regularities and irregularities in various types of problems. **Communication:** Organize and consolidate thinking using group discussions, written explanations, journals and presentations. **Connections:** Explore historical and multicultural contributions to mathematics. Recognize and apply mathematical ideas and relationships in areas outside the classroom and in other curricular areas such as art and science. **Representation:** Use a variety of visual representations including graph paper and technology to explore and formulate conjectures	See logarithm suggestions in November. -Have students find and bring data through internet search, magazines, newspapers and almanacs Population problem: P=PoA^t given P, solve for t Money, compound interest, doubling time Half life Give students data sets that are not perfect models and ask what might be done to make them fit a familiar model. Use cooperative structures to help students communicate ideas. CBL, CBR, graphing calculators (delta list for rates of change), Transformations Application for TI-83
January	Algebra Data and Statistics Algebra Geometry & Algebra Algebra	**2.1.1, 2.2.1, 2.3.1**- Explore Trigonometric functions. Include each of the following ideas as part of that exploration. (Some ideas may be investigated concurrently rather than sequentially) **5.1 a.** - Gather and plot real-world data **5.1.1 b**. - Discover the sinusoidal regression equation appropriate for the data **2.1.1 c**. - Generalize the equation **2.1.1, 2.3.2, 2.3.3 d.** - Identify the domain, range and other attributes for the equation including asymptotes and end behavior. Recognize symmetric properties of even and odd functions **3.2.1, 2.3.5 e.** - Perform transformations and identify the effect of changing parameters in those transformations of the function **2.2.1 f.** - Solve equations including real-world situations **5.1.2 g**. - Interpolate and extrapolate from data using regression equations **2.2.1 h**. - Solve inequalities including real-world situations **2.2.3, 2.2.4 I** - Combine and compose functions students have previously experienced, identifying the domain and range of the resulting function. 1. Use algebraic methods 2. Use Technology **2.2.8 j.** Approximate instantaneous rates of change, and find average rates of change using graphical and numerical data.	**Problem solving:** Reflect and evaluate the thinking processes involved in problem solving. Guess and check. Compare and contrast one trig function to another, e.g. how are cosine and sine functions alike? Different? Find a pattern, e.g. cyclic patterns. **Reasoning and proof:** Make and investigate conjectures about transformations of trig functions. **Communication:** Employ precise language and notation in writing about and in representing mathematical ideas. Explain and justify problem solving procedures. **Connections:** Find mathematical concepts in internet, newspapers, television, e.g. weather is cyclic. Apply mathematical ideas in areas outside the classroom, e.g. music, sound. Connect to concepts previously learned, "Where have we seen this in the past?" **Representation:** Use a variety of visual representations including technological models to explore and formulate conjectures related to the concepts. Represent situations graphically.	Demonstrate a simple area model using AlgeBlocks to review finding monomial and binomial factors. Have students find and bring data through internet search, magazines, newspapers and almanacs Use Cooperative Structures for practicing procedures. Graphing calculator (delta list for rates of change), CBL, CBR, Transformation Application for TI-83 CBL Microphone probe Tuning forks Light probe held to fluorescent light lets you see alternating current (CBL) Slinky bouncing over motion detector Tides and phases of the moon Weather (average temperatures are cyclic) Give them the graph from data and have them find the equation

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February	Number and Operation Geometry Algebra	**2.1.1** - Identify the domain, range and other attributes of inverse trig functions **1.2.1, 1.1.2** - Introduce the need for vectors and represent them graphically and symbolically. Add, subtract and perform scalar multiplication on vectors in real-world settings using a variety of techniques with and without the use of technology **1.3.1** - Perform the operations of dot and cross product on vectors **1.3.1** - Analyze properties of vectors and their effects on vector operations **3.1.2** - Analyze problems and solutions involving vectors using algebraic and graphical techniques **2.1.3** - Represent simple linear and quadratic functions parametrically. Compare and contrast with function representation. **2.1.3** - Recognize the power and beauty of parametric representation by graphing more complex parametric relations. **2.3.1** - Represent quantitative real-world situations using vector and parametric equations **2.1.4** - Identify vector-valued functions using a variety of approaches including algebraic and graphical.	**Problem solving:** Select, use and justify appropriate methods for computing from among mental computation, estimation, paper and pencil, calculator or computer. Draw a picture or diagram. Work backwards. **Reasoning and proof:** Identify information as necessary, sufficient, or extraneous and conclusions as valid or invalid. **Communication:** Use precise language and notations. Express ideas verbally, symbolically and in writing. **Connections:** Establish connections among mathematical expressions, physical models, pictorial representations and real-world situations. **Representation:** Use a variety of visual representations including graph paper and technology to explore and formulate conjectures.	Graphing calculator Use cooperative structures Force diagrams Navigation Coefficient of Friction CBL, Motion Detectors (two detectors hooked to CBL to make parametric graphs) Motion problems in two dimensions (baseball into the wind) A ball dropping versus a ball thrown horizontally will hit the ground at the same time can be modeled with parametrics Use coordinates to create shapes on graph paper as an introduction to parametrics Vary the parameters in parametric equations and look for the effect in the corresponding graph to apply inductive reasoning Cycloids, Spiral of Archimedes
March	Number and Operation Geometry Number and Operation Geometry	**1.2.2** - Introduce the need for polar coordinates and convert polar to rectangular and rectangular data to polar **3.2.2** - Graph or sketch polar functions using technology and other techniques, then compare/contrast to rectangular functions **1.1.1, 1.3.2** - Review addition, subtraction and multiplication of complex numbers and analyze the properties as they effect operations in rectangular and polar form **1.1.1** - Find the absolute value of complex numbers **1.2.2** - Represent complex numbers in rectangular and polar form and convert between the two. **3.1.1** - Introduce conic sections a. What is a conic section? b. Why is it named "conic section"? c. Suggest a few real-world applications for conic section **3.1.1** - Determine and analyze the characteristics of graphs and the related equations of conic sections	**Problem solving:** Solve a simpler or related problem. Choose an appropriate operation. Make a list, table, graph or equation. "How does today's work compare/contrast with what we have done in earlier units of study, e.g. comparing polar to rectangular coordinates. **Reasoning and proof:** Use formal and informal proofs to draw conclusions regarding properties of operations on complex numbers **Communication:** Use journal entries or other opportunities for writing. Use class and small group discussions. **Connections:** Connect to real-world situations. Find applications outside the classroom **Representation:** Use physical, graphical and technological models	Graphing calculator Cartography, navigation Let students discover polar graphs and the effects of changing equation parameters on the graph, e.g. the effect of changing n in the equation r = a cos (n □) Fractals (the Mandelbrot and Julia set). Computer programs on internet allow investigation. "Fractint" Cut a cone for conics Optics, light rays, headlights, telescope, satellite dishes an lenses Sound chamber (ellipse). See architectural models Lithotripter (ultrasonic device to break up kidney stones)

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April	Algebra Data and Probability	**2.2.6** - Solve systems of non-linear equations and inequalities **2.1.5** - Identify and generate simple numerical sequences finding the rule that applies **2.1.5** - Identify and generate arithmetic and geometric sequences and series recursively and explicitly using correct notation. **2.3.1** - Represent quantitative, real-world situations using sequences and series **2.1.6** - Identify geometric sequences as convergent or divergent **2.1.6** - Identify geometric series as convergent or divergent by using the sequence of partial sums a. numerically b. graphically **5.2.1, 5.1.3** - Review the concept of probability. Find sample spaces and probability distributions in simple cases. Identify how sample statistics reflect population parameters **5.2.2** - Introduce, compare and contrast independent and dependent events and calculate the probability of each.	**Problem solving:** Select, justify and use appropriate methods for computing. Propose and value alternative approaches. Look for a pattern. Identify counter examples. Solve a variety of multi-step, complex, non-routine problems **Reasoning and proof:** Realize that observing a pattern and making a conjecture does not constitute proof. **Communication:** Investigate ideas and consolidate thinking through discussion and opportunities for writing. **Connections:** Explore historical and multicultural contributions. Find real-world applications. **Representation:** Use physical models, visualizations, and appropriate symbolic notation to represent ideas.	Graphing calculators, sequence graphing mode Finance (compound interest) Pascal's Triangle Fibonacci sequence applications in real life (biology) Simulations, Probability App on TI-83, coins, dice, random number generation, marbles in a bag, winning prizes, roulette, cards Surveys and opinion polls
May	Data and Probability Algebra	**5.2.3** - Introduce the concept of conditional probability and calculate the conditional probabilities of an event. **5.2.4** - Introduce the concept of compound events and calculate the probability of a compound event. **5.2.5** - Introduce the concept of expected value (weighted average) **5.2.5** - Calculate and interpret the expected value of random variables in simple cases **2.1.7** - Introduce the Binomial Theorem and raise a binomial to a power using the Binomial Theorem **2.3.6** - Review all functions by choosing the best family of functions to a particular data set.	**Problem solving:** Work backwards. Eliminate possibilities. "Did anyone think of this in a different way? **Reasoning and proof:** Formulate counter examples. **Communication:** Use precise language and notation. Express ideas clearly. **Connections:** Formulate real-world situations and establish connection to the mathematical representation. **Representation:** Use appropriate symbolic notation.. Represent problem situations numerically and algebraically	See probability activities in April Have students find and bring data through internet search, magazines, newspapers and almanacs Connect the Binomial Theorem to probabilities of binomial random variables.